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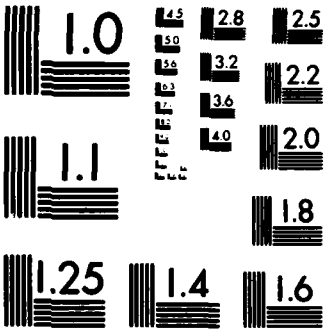

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RESULTS OF A WIND - DEWPOINT CONDITIONAL CLIMATOLOGY TABLE EVALUATION

Michael J. Kelly, Capt, USAF

August 1979

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AIR WEATHER SERVICE (MAC)
Scott AFB, Illinois 62225

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

An evaluation of two types of conditional climatology tables is described. Results show that the wind-stratified conditional climatology (WSCC) tables and the wind-dewpoint conditional climatology (WDCC) tables have nearly equivalent skill. The author concludes that there is not sufficient justification for replacing WSCC tables with WDCC tables.

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August 1979

RESULTS OF A WIND-DEWPOINT CONDITIONAL CLIMATOLOGY TABLE EVALUATION

Capt Michael J. Kelly

1. Introduction

St. Louis University, under contract to the Air Force Geophysics Laboratory, developed a conditional climatology model for the Air Weather Service (AWS). This conditional climatology model was used to generate Wind-Dewpoint Conditional Climatology (WDCC) tables. The WDCC model is described by Martin (1975). The most obvious differences between the WDCC tables and traditional Wind-Stratified Conditional Climatology (WSCC) tables are as follows:

a. The use of dewpoint depression as a climatology stratifier.

b. The WDCC tables are derived from a model, not just data. A probability is given for every situation, even those which most likely will never occur.

c. The resultant median cloud height is given for every initial condition.

The WDCC tables were evaluated at Randolph AFB by Det 1, 24th WS forecasters. The two evaluation periods were December 1974 through January 1975 and January 1976 through February 1976. In these two evaluations, the WDCC tables were inferior to the WSCC tables. The HQ AWS staff recommended that a more extensive evaluation be conducted prior to producing WDCC tables for all AWS detachments. Compared with WSCC tables, the WDCC tables are more cumbersome to use and more expensive to produce. Therefore, the WDCC tables must demonstrate consistently superior skill to justify their production.

2. Evaluation Description

USAFETAC converted the St. Louis University WDCC computer program to run on the USAFETAC computer. WDCC tables were produced at USAFETAC, and sent to evaluation units. The eight weather detachments that participated in the evaluation are given in Appendix C.

The WDCC and WSCC forecasts were recorded on keypunch coding forms. A description of the data format as well as the ceiling and visibility categories is given in Appendix A.

The WSCC tables used at Kunsan AB combine categories B and C, and categories K and L. Both the WSCC and WDCC were verified using this five category system.

The completed keypunch coding forms were sent to HQ AWS/DN. HQ MAC/AD keypunched computer cards. The Defense Commercial Communications Office computer was used to verify the WSCC and WDCC forecasts.

Occasionally the WSCC tables cannot provide a forecast because the initial condition was never observed during the period of record of the tables. In such situations, an equal probability was assigned to each of the categories.

3. Results

The results are given in Appendix B. The Brier score (Brier and Allen, 1951), or P-score, ranges from 0 to 2 with lower values indicating greater skill, given the same climatology. Contingency tables were developed by selecting the forecast category with the highest probability. The percent correct, percent of three or more category busts, and prefigurance of the lowest three categories were all derived from these contingency tables. Prefigurance equals hits divided by total occurrences.

Before considering the results it should be noted that two errors were discovered in the USAFETAC WDCC program subsequent to WDCC table production. First, observations with winds from 360 degrees are not included in the Travis AFB WDCC tables. Second, with the exception of the Fort Rucker, Hurlburt AFB, and Wright-Patterson AFB WDCC tables, visibilities below one mile were sometimes assigned to the wrong visibility category. These errors are believed to have only a minor effect on the overall results.

There are only minor differences in skill between the WDCC and WSCC tables. The WDCC shows small improvements in the Brier score and percent of three or more category busts. The WSCC is slightly better in terms of percent correct and the prefigurance of the three poorest weather categories. None of these differences is highly significant.

Paired comparisons were made using the results given in Appendix B. For example, if the WDCC P-score for the 40 entries in Appendix B is subtracted from the WSCC P-score, the mean difference, $\bar{X}$, is .00325 and the standard deviation, S, is .0252. The claim is that the WDCC and WSCC P-scores may be viewed as a sample from a population with a mean difference of zero. In order to test this claim, the departure of the sample mean, $\bar{X}$, from a hypothetical mean, N, may be evaluated by computing the ratio

$$Z = \frac{\bar{X} - N}{S/\sqrt{n}}$$

where n is the number of data points in the sample. For the sample described above

$$Z = \frac{.00325 - 0}{.0252/\sqrt{40}} = 0.816.$$

At the .05 significance level, $|Z|$ must be ≥ 1.96 to reject the claim that there is no difference in the tables. A value of 0.816 corresponds to a significance level of 0.42.

Any effects of the programming errors described above can be eliminated by considering only ceilings at all stations except Travis AFB. The t-distribution tables should be used since 18 values is considered a small sample (Panofsky and Brier, 1968). The P-score data results in a mean difference of -0.002 and a standard deviation of 0.022. The Fort Rucker, Hurlburt AFB, and Wright-Patterson AFB results are unaffected by the previously mentioned programming errors. Using the P-score data and considering only the ceilings, $|t| = 0.374$. At the .05 significance level, $|t|$ must be ≥ 2.110 to reject the claim that there is no difference in the tables.

The evaluation results indicate that there is little difference in forecast skill between WDCC and WSCC tables. There is, therefore, no justification to recommend WDCC as a replacement for WSCC.

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APPENDIX A

EVALUATION DATA FORMAT

Col	Description
1-2	Month of year (01, 02,..., 12)
3-4	Day of the month (01, 02,..., 31)
5-6	Hour of the day (2) (00, 01,..., 23)
8	Initial Ceiling Category ($0 \leq A < 200$; $200 \leq B < 500$, $500 \leq C < 1000$, $1000 \leq D < 3000$, $3000 \leq E < 10000$, $F \geq 10000$)
10-15	3 hour ceiling forecast from the WSCC tables. Use Col 10 for the probability of Cat A, Col 11 for Cat B, etc. The numbers in the WSCC tables must be rounded up or down. For example, 70-74 = 7, 75-79 = 8.
17-22	6 hour ceiling forecast from WSCC
24-29	3 hour ceiling forecast from WDCC
31-36	6 hour ceiling forecast from WDCC
38	3 hour ceiling forecast issued by the detachment. Use the six categories described above rather than the existing AWS verification categories.
39	6 hour ceiling forecast issued by the detachment.
41	Ceiling category observed at initial forecast hour +3.
42	Ceiling category observed at initial forecast hour +6.
44	Initial visibility category ($0 \leq J < \frac{1}{2}$, $\frac{1}{2} \leq K < 1$, $1 \leq L < 2$, $2 \leq M < 3$, $3 \leq N < 6$, $0 \geq 6$)
46-51	3 hour visibility forecast from WSCC
53-58	6 hour visibility forecast from WSCC
60-65	3 hour visibility forecast from WDCC
67-72	6 hour visibility forecast from WDCC
74	3 hour visibility forecast issued by the detachment
75	6 hour visibility forecast issued by the detachment
77	Visibility category observed at initial forecast hour +3
78	Visibility category observed at initial forecast hour +6

APPENDIX B - EVALUATION RESULTS

	P-SCORE				% CORRECT			% OF ≥ 3 CATEGORY BUSTS			PREFIGURANCE OF LOWEST 3 CATEGORIES		
	SAMPLE CLIMO	WSCC	WDCC	WSCC* minus WDCC	WSCC	WDCC	WDCC* minus WSCC	WSCC	WDCC	WSCC* minus WDCC	WSCC	WDCC	WDCC* minus WSCC
Fort Rucker, AL													
3/78-5/78													
364 Forecasts													
3 Hr Cig	.38	.24	.25	-.01	84.9	83.2	-1.7	1.65	1.37	+.28	33.3	42.9	+ 9.6
6 Hr Cig	.39	.29	.27	+.02	79.7	79.9	+ .2	1.37	1.10	+.27	19.0	42.9	+23.9
3 Hr Vis	.18	.18	.16	+.02	89.3	89.0	- .3	2.75	1.92	+.83	9.1	27.3	+18.2
6 Hr Vis	.14	.15	.13	+.02	92.0	93.1	+1.1	2.47	2.20	+.27	0.0	20.0	+20.0
Fort Rucker, AL													
12/77-02/78													
361 Forecasts													
3 Hr Cig	.56	.41	.39	+.02	70.9	72.6	+1.7	2.22	1.66	+.56	31.0	45.2	+14.2
6 Hr Cig	.57	.44	.42	+.02	67.0	67.0	+ 0	4.71	2.70	+2.01	14.9	17.0	+ 2.1
3 Hr Vis	.25	.21	.19	+.02	87.3	85.9	-1.4	4.76	3.60	+.56	42.9	28.5	-14.4
6 Hr Vis	.28	.27	.25	+.02	83.4	84.2	+ .8	4.43	4.76	-.27	5.3	15.8	+10.5
Hurlburt AFB, FL													
12/77-05/78													
473 Forecasts													
3 Hr Cig	.55	.40	.41	-.01	68.1	69.1	+1.0	4.44	3.17	+1.27	27.9	32.8	+ 4.9
6 Hr Cig	.55	.46	.43	+.03	66.8	68.1	+1.3	6.77	5.71	+1.06	14.5	25.8	+11.3
3 Hr Vis	.50	.45	.42	+.03	69.3	68.9	- .4	5.92	4.44	+1.48	8.8	11.8	+ 3.0
6 Hr Vis	.44	.41	.39	+.02	74.4	75.7	+1.3	6.55	4.02	+2.53	6.3	6.3	+ 0
Kunsan AB, Korea													
03/77-05/77													
367 Forecasts													
3 Hr Cig	.52	.36	.38	-.02	75.7	75.2	- .5	7.08	5.99	+1.09	37.0	45.7	+8.75
6 Hr Cig	.53	.46	.45	+.01	69.2	67.0	-2.2	8.99	9.26	-.27	29.4	31.4	+ 2.0
3 Hr Vis	.34	.30	.27	+.03	79.8	81.7	+1.9	5.72	5.18	+ .54	16.7	33.3	+16.6
6 Hr Vis	.34	.35	.33	+.02	76.8	77.7	+ .9	9.26	8.45	+ .81	0.0	0.0	+ 0
Kunsan AB, Korea													
06/77-08/77													
368 Forecasts													
3 Hr Cig	.56	.44	.49	-.05	71.5	67.9	-3.6	8.70	9.78	-1.08	45.3	48.4	+ 3.1
6 Hr Cig	.56	.52	.56	-.04	60.9	60.1	- .8	14.4	16.0	-1.60	14.1	25.0	+10.9
3 Hr Vis	.37	.33	.31	+.02	78.3	79.6	+1.3	7.88	4.89	+2.99	8.0	16.0	+ 8.0
6 Hr Vis	.36	.35	.32	+.03	78.0	78.3	+ .3	7.34	5.98	+1.36	4.30	8.70	+ 4.4

*Positive values indicate WDCC was better than WSCC

	P-SCORE				% CORRECT			% OF ≥ 3 CATEGORY BUSTS			PREFIGURANCE OF LOWEST 3 CATEGORIES		
	SAMPLE CLIMO	WSCC	WDCC	WSCC* minus WDCC	WSCC	WDCC	WDCC* minus WSCC	WSCC	WDCC	WSCC* minus WDCC	WSCC	WDCC	WDCC* minus WSCC
Langley AFB, VA													
12/77-02/78													
359 Forecasts													
3 Hr Cig	.52	.29	.29	0	79.4	79.9	+ .5	1.11	.836	+ .274	47.8	45.7	-2.1
6 Hr Cig	.57	.44	.43	+.01	68.5	69.6	+1.1	5.57	3.62	+1.95	30.6	32.7	+2.1
3 Hr Vis	.41	.26	.25	+.01	81.9	81.9	+ 0	1.39	2.23	- .84	38.5	23.1	-15.4
6 Hr Vis	.39	.29	.29	0	80.5	78.6	-1.9	5.57	4.46	+1.11	22.2	3.7	-18.5
Mildenhall AB, UK													
9/77-02/78													
723 Forecasts													
3 Hr Cig	.69	.55	.54	+.01	62.2	62.2	+ 0	1.94	1.94	0	40.4	38.5	-1.9
6 Hr Cig	.69	.65	.65	0	49.8	50.9	+1.1	4.15	3.46	+ .69	19.0	19.0	+0
3 Hr Vis	.54	.38	.35	+.03	74.1	73.0	-1.1	1.38	1.11	+ .27	45.6	25.0	-20.6
6 Hr Vis	.54	.46	.40	+.06	65.8	67.9	+2.1	4.56	3.18	+1.38	31.9	20.8	-11.1
Ramstein AB, GE													
11/77-02/78													
479 Forecasts													
3 Hr Cig	.74	.58	.59	-.01	61.2	58.2	-3.0	1.67	1.67	0	54.8	32.9	-21.9
6 Hr Cig	.74	.68	.71	-.03	44.3	45.3	+1.0	2.51	1.46	+1.05	27.0	13.5	-13.5
3 Hr Vis	.69	.49	.52	-.03	64.3	60.8	-3.5	1.67	1.25	+ .42	52.1	40.6	-11.5
6 Hr Vis	.70	.59	.65	-.06	55.7	49.3	-6.4	4.38	3.76	+ .62	42.7	21.9	-20.8
Travis AFB, CA													
12/76-02/77													
360 Forecasts													
3 Hr Cig	.37	.24	.25	-.01	83.6	83.6	+ 0	4.17	3.33	+ .84	45.2	40.5	- 4.7
6 Hr Cig	.39	.31	.32	-.01	77.8	76.4	-1.4	6.94	8.89	-1.95	28.9	22.2	- 6.7
3 Hr Vis	.65	.43	.43	0	68.9	69.2	+ .3	5.00	6.94	-1.94	36.8	31.6	- 5.2
6 Hr Vis	.65	.49	.51	-.02	64.4	59.7	-4.7	9.44	11.4	-1.96	33.3	16.7	-16.6
Wright-Patterson AFB, OH													
12/77-02/78													
359 Forecasts													
3 Hr Cig	.71	.54	.53	+.01	62.1	62.1	+ 0	1.39	1.67	-.28	34.6	42.3	+7.7
6 Hr Cig	.72	.61	.61	.00	54.3	53.2	-1.1	2.79	3.34	-.55	25.5	27.2	+1.7
3 Hr Vis	.55	.42	.41	+.01	69.9	66.3	-3.6	4.74	5.57	-.83	27.5	20.0	-7.5
6 Hr Vis	.58	.52	.56	-.04	61.0	57.4	-3.6	9.75	9.75	0	7.8	5.9	-1.9

APPENDIX C

DETACHMENTS TAKING PART IN THE TEST

Det 9, 5WS, 5WW, Ft Rucker AIN, AL

Det 75, 3WS, 5WW, Hurlburt AFB (Eglin 9), FL

Det 10, 30WS, 1WW, Kunsan AB, KS

Det 7, 3WS, 5WW, Langley AFB, VA

Det 15, 31WS, 2WW, Mildenhall RAF, UK

Det 2, 31WS, 2WW, Ramstein AFS, GE

Det 2, 7WW, Travis AFB, CA

Det 15, 15WS, 7WW, Wright-Patterson AFB, OH


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